JUN 6 1977

06152929

GRACE

Zonolite
Construction Products Division

DISTRIBUTION

E. S. Wood
~~J. W. Wolter~~
H. C. Duecker
B. R. Williams
J. C. Yang
O. M. Favorito
F. W. Eaton
R. H. Locke
R. E. Schneider
D. D. Walczyk/Proj. File

KS EXHIBIT 216 8/21/02 Yang

15152189

J6152330

BINDER DEVELOPMENT PROGRAM P-204
WEEDSPORT SPRAYING TESTS
MARCH, 1977

Objectives:

- Determine how effective various water soluble additives are in reducing the airborne fibers.
- Evaluate several addition rates for each solution.
- Evaluate the bagging spout versus the stoner product discharge as a location for spray addition.
- Determine the yield loss caused by spraying.
- Establish the design criteria necessary for multiple plant installations.

Background:

Testing conducted at Weedsport as reported Feb. 25, 1977 indicated that water spraying of vermiculite could reduce airborne fibers. However, tests also indicated the water will evaporate in storage. An additive was, therefore, sought which would remain with the vermiculite and keep the fibers bound to the material.

At the present time, the company has established a goal of 0.2 f/ml on a time weighted average (T.W.A.) and 1.0 f/ml ceiling based on 15 mins. exposure for consumer products (attic fill, terralite vermiculite, pool cushion). For non-consumer products (masonry fill, etc.) currently the O.S.H.A. Standard of 2.0 f/ml T.W.A. and 10 f/ml ceiling applies.

The tests reported herein were a step in binder development which established the data bases for subsequent tests series using either CMC or starch as binders. Tests were run the week of May 9 using the newly installed binder addition spray system. These tests will further define the binder and addition rate to be used in production.

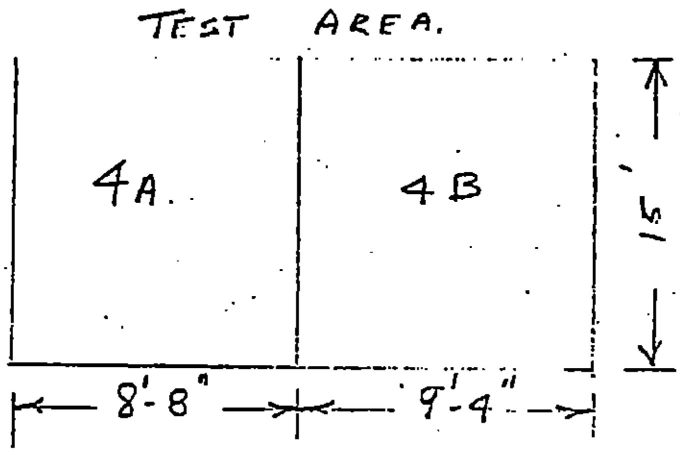
Test Methods:

- Plant Binder Addition

This test series was conducted as outlined in a memo from R. E. Schneider to J. W. Wolter (Appendix Page A-8) with modifications as outlined in Table I below.

 06152932

- Attic Fill Test, Continued



- Test 4B -
Twenty 4 cu. ft. bags of bound attic fill (0.2 qts./cf) were carried to the attic. Both men emptied bags between floor joists (7 1/8" deep) in a stooped position and worked together on their knees leveling the fill with a 2 by 4. The 20 bags filled approximately half the attic space (designated 4B on preceeding diagram). The attic was then vacated for 30 min. and any residual dust vented through an open door into a bedroom.

- Test 4A (Control) -
Twenty 4 cu ft. plastic bags of attic fill were carried to the attic for the remainder of the job. Using the same technique, fifteen bags were required to fill the remaining attic space (designated 4A on preceeding diagram).

- Masonry Fill Test

A foundation addition 14' x 18' (8" concrete blocks, 11 courses high) was used as a test site.

- Test 6E

  - 6 - 4 cf clear plastic bags of L#3 asphalt masonry fill bound with 0.26 qt./cf 5% sodium silicate solution poured in the 18' wall.

  - Time required to pour six bags was 15 minutes (2.5 min./bag)

15152192

 06152933

- Masonry Fill Test, Continued

    - Kilmer poured bags from inside the wall with the wind at his back. Two personnel sampling pumps (right and left shoulders) were attached to obtain average exposure samples.

- Test 7D

    - 3½ - 4 cf paper bags of L#4 asphalt masonry fill bound with 0.25 qt./cf 5% sodium silicate solution poured in the 14' wall.

    - Time required to pour 3½ bags was 17 minutes (4.9 min./bag).

    - Personnel sampling was the same as in 6E above.

Conclusions:

1. Sodium silicate sprayed at the bagging spout and stoner discharge appeared to reduce the airborne fiber count to lower levels than other materials tested. The fiber level on #1 Libby appears to satisfy the 0.2 f/ml level for a consumer product. (Test 4E.) Subsequent to these tests, sodium silicate was ruled out as a binder candidate because it dries brittle and may have deleterious effects on horticultural products.

2. All solutions tested had some success in reducing fiber counts. With the exception of oil emulsion on #4 ore, both clear and oil emulsion were able to meet the O.S.H.A. standard.

3. The results of drop tests are showing inconsistencies; repeatability may not be satisfactory for drawing firm conclusions.

4. There is a shrinkage of the treated vermiculite after bagging resulting in a loss of yield. To obtain total yield, production yield losses must be added to yield loss due to shrinkage in the bag.

5. The yield loss is most severe in #1 Libby. Masonry fill yield losses appear to be the least affected by spraying.

6. The yield losses increase with increased addition rates.

 06152934

Conclusions, Continued:

7. The yield loss of #1 Libby was less in paper bags than in plastic bags.

8. Shrinkage in the bag is not a function of position on the pallet.

Recommendations:

1. A series of drop tests should be conducted on the same material to properly evaluate the variations in fiber levels and the validity of the test method.

2. Drop tests should be conducted on paper versus plastic bags at the same addition rate.

3. When the final additive and flow rate is selected it will be necessary to run a total yield test.

4. In future tests several concentrations of the additives should be tried at the same flow rate.

Results:

Results are summarized in Tables 3 thru 10, pages A-1 thru A-7 in the Appendix. Some key points to note are discussed below.

1. The 5% sodium silicate solution, applied to L#1 product at the stoner discharge at rates ranging from 0.39 to 0.88 qt./cf reduced the airborne fiber level to about the 0.2 f/ml goal. The reduction in airborne fibers from the control sample to the bound sample was approximately 90%. (Test 4, Table 6.)

2. The same 5% sodium silicate solution was applied to asphalt masonry fill made from both L#3 and L#4 (Tests 6 and 7, Table 6). The binder was applied at rates ranging from 0.06 to 0.26 qt./cf and spray was at the bagging spout. At a rate of 0.26 qt./cf (Test 6E) a 75% reduction in airborne fibers from the control sample to the bound sample was realized. This meets the 2.0 f/ml requirement for masonry fill. The results of Test 7 were disappointing and erratic.

Results, Continued:

3. The test results show, that although the fiber levels are still unacceptably high, the 5% oil emulsion and 5% clear solutions had some success in reducing the fiber levels (Tests 1,2 and 3, Table 6). It may be worthwhile to check higher concentrations of these additives in future testing.

4. Standard yield tests were done only on selected tests as shown in test outline Table 1. In Test No. 1F, using #4 Libby, a spray rate of 0.70 qts./cf in the stoner discharge gave a production yield of 94.5% of assay yield. The shrinkage in the bag, in the same test, resulted in a yield loss of 9%, so that the total yield was 82% of assayed yield. Similarly, as shown in Table 5, Page A-2, the total yield in Test 2D was 91.9%, 3D = 88.6% and 4E = 85.2%.

5. The losses due to shrinkage in the bag are shown in Table 3, Page A-1. The loss is most severe in #1 Libby (Tests 4&5) with the losses higher in plastic bags than in paper bags (Test 5). The higher loss in plastic bags may be accounted for by the plastic retaining more of the sprayed water while the paper allows the moisture to escape. A check of fiber levels between the two products should be conducted to determine if the lower level of moisture in the paper bag would give higher fiber levels.

   The shrinkage shown in Table 3, Page A-1 does not take into account the shrinkage occurring during the few minutes between bagging and the bag being weighed and then volume checked. Subsequent tests have shown this could amount to 0.15 cu. ft. which would be 3.8% on a 4 cu. ft. bag.

   Volume recheck data (Table 9, Page A-6) shows that the loss is not caused by position on the pallet. Bags on the top of the pallet shrunk as much as bags in the middle or bottom. Masonry fill appears to be the least affected.

   Losses increase with increased spray rate as shown in Table 4, Page A-2. The effect of this increased spray rate varies according to the ore with #1 being the most affected.

   The volume shrinkage due to binding is further demonstrated by the reduction in coverage in Test 4B versus Test 4A.

Results, Continued:

Only 15 bags of the unbound material (4A) were required to fill the same volume that took 20 bags of the bound material (4B).

6. Fiber analysis of the personnel samples taken as the men applied the attic fill are shown in Table 10, Page A-7. The total T.W.A. of 0.326 f/ml for the bound sample approaches the goal of 0.2 f/ml. The actual fiber count of 2.235 f/ml is, however, substantially higher than the 0.717 f/ml result obtained in the drop test of the 4B material.

   The actual fiber count is converted to an estimated T.W.A. by assuming that actual exposure occurs for only 2 hours in an 8 hour working day. Hence, 2.235 x 2/8 = 0.559 f/ml.

7. Masonry fill test job results are reported in Table 11, Page A-7. The total T.W.A. for both 6E and 7D materials is well under the acceptable level of 2.0 f/ml. The actual average fiber counts from the personnel samples for both the 6E and 7D materials are well below the fiber counts obtained in the drop tests for the same materials.

Material	Fiber Count - f/ml	
	Drop Test	Job Test
6E	1.712	0.575
7D	13.253	2.515

8. Partial and total T.W.A. results are calculated by taking the actual exposure minutes divided by 480 minutes (8 hrs.) and multiplying this ratio times the fiber count from the sampler.

Discussion:

The results of drop tests as shown on Table 6, may be suspect when noting the results of Tests 4A and 4B in Table 2 below. Drop tests conducted to this point have been mainly one time tests. There appear to be inconsistencies showing up in these results as demonstrated by the results of Table 2. Note the three average f/ml results for the control material. The count of fibers released for both 4A and 4B materials went up substantially with the 8 day interval between tests. Similar increases were measured by the personnel samples taken when 4A and 4B materials were used in the

Discussion, Continued:

attic fill test. In order to evaluate the variables a test should be conducted where a statistically significant number of drop tests are conducted on the same material and the spread of the data evaluated.

TABLE 2

Date Produced	Test No.	Date Tested	Spray Rate Qts./ft.^{3}	Location	Fiber Min.	Analysis Max.	f/ml Avg.
3/23	4A (Control)	3/29		-	1.28	3.42	2.07
3/23	4B	3/29	0.37	Bag.Spout	0.43	0.86	0.717
3/26	Inv. #1L	3/29	-	-	3.85	5.56	4.563
3/23	4A (Control)	4/6	-	-	2.57	5.99	4.99
3/23	4B	4/6	0.37	Bag.Spout	0.43	2.57	1.355
Home Sampling Attic Fill Job.							
3/23	4A (Control)	4/6	-	-	3.62	4.28	3.95
3/23	4B	4/6	0.37	Bag.Spout	1.94	2.53	2.235

Personnel samples (Table 6, Page A-3) taken during each test were all low with the exception of Test 7. In this test, the #4 masonry fill was dusting at the bagging spout, particularly at the highest spray rate. The higher fiber levels reflect this.

Operation of the furnace equipment was normal except at the end of Test 7 the baghouse hopper plugged and would not discharge. Inspection of the bags showed the material cleaned off the bags alright but appeared to agglomerate in the bag hopper. Visual inspection of the dust showed round balls up to ¼" diameter in the baghouse discharge which would pulverize at the touch. A sample was taken for analysis to see if sodium silicate might be causing the agglomeration. Apparently the sample dried and could not be analyzed.

Discussion, Continued:

The bagging spout is the best place to locate the spray nozzle. The material falls through the spray resulting in a better distribution throughout the material. While one result (Table 3, Test 4C), for material sprayed at the stoner discharge, does give the lowest fiber count in the drop test, the bagging spout also gives a low level (Table 3, Test 4B). Application at the stoner discharge would cause dusting unless extensive design modifications were done to the stoner and vent system.

The exposure levels taken on the small attic fill job (Table 10, Page A-7) are above the established goals for a consumer product. However, the material tested (4B) had binder added at 0.37 qts./cf. A higher addition rate would have lowered the exposure levels.

The exposure levels taken on the small masonry fill job are below the O.S.H.A. standard. Also as Table 6, Page A-3 shows the f/ml T.W.A. is a function of addition rate, and the rate of 0.26 qts./cu. ft. is fairly low.

M. M. Williams

M. M. Williams

MMW:mt

A-? 06152939

TABLE 3

Test No.	Binder Location & Rate	Avg. Bagged cu. ft.	Volume Loss %	Avg. Bulk Density Produced	Avg. Bulk Density Recheck	Drop Test f/ml Avg.
1A	Control #4L	.05	1.3	7.7	7.8	6.582
1B	B.S. @ 0.03	.13	3.4	8.3	8.6	10.333
1D	B.S. @ 0.18	0.31	8.3	9.0	9.8	5.203
1E	S.D. @ 0.39	0.26	6.3	8.5	9.0	7.270
1F	S.D. @ 0.70	0.38	9.0	8.8	9.6	3.848
2A	Control #2L	0.04	1.0	4.2	4.3	8.767
2B	B.S. @ 0.29	0.13	3.1	5.0	5.2	2.280
2C	S.D. @ 0.39	0.20	4.9	5.1	5.4	1.355
2D	S.D. @ 0.65	0.24	5.9	5.6	6.0	1.072
3A	Control #3L	0.13	3.1	5.0	5.1	4.70
3B	B.S. @ 0.26	0.19	4.6	5.7	6.0	2.495
3C	S.D. @ .70	0.27	6.7	6.6	7.1	2.495
3D	S.D. @ .48	0.24	5.9	6.0	6.3	2.068
4A	Control #1L	0.07	1.7	4.6	4.7	2.07
4B	B.S. @ 0.37	0.49	11.8	5.6	6.3	0.717
4C	S.D. @ 0.39	0.44	10.8	5.5	6.2	0.215
4D	S.D. @ 0.61	0.61	15.0	6.1	7.2	0.43
4E	S.D. @ 0.88	0.43	10.5	6.4	7.1	0.143
5A	B.S. @ 0.39 #1L	0.43 Plastic 0.32 Paper	10.4 8.0	5.7	6.3 6.4	0.81
5B	S.D. @ 0.47	0.51 Plastic - Paper	12.3 -	5.6	6.4 -	1.21
5C	S.D. @ 0.80	0.59 Plastic 0.31 Paper	14.3 7.8	6.3	7.3 7.0	0.50
5D	B.S. @ 0.05	0.25 Plastic 0.16 Paper	6.0 4.1	4.9	5.0 5.2	3.105
5E	B.S. @ 0.16	0.40 Plastic 0.25 Paper	9.8 6.3	5.2	5.6 5.6	1.428
6A	Control #3L-M.F.	0.11	2.8	5.3	5.4	6.843
6B	B.S. @ 0.06	0.17	4.1	5.3	5.6	5.132
6C	B.S. @ 0.10	0.22	5.3	5.5	5.9	2.638
6E	B.S. @ 0.26	0.25	6.1	5.9	6.2	1.712
7A	Control #4L-M.F.	0.07	1.8	7.7	7.8	8.48
7B	B.S. @ 0.08	0.11	2.8	7.8	8.0	6.625
7C	B.S. @ 0.09	0.04	1.0	7.8	7.9	4.918
7D	B.S. @ 0.25	0.10	2.5	8.3	8.5	13.253

15152199

123Z00193

A-2

06152940

TABLE 4

Ore	Flow Rate Qts./ft.^{3}	Yield Loss	Increase In Loss With Increased Flow Rate
#4	0.39	6.3%	42.9%
	0.70	9.0%	
#2	0.39	4.9%	20.4%
	0.65	5.9%	
#3	0.26	4.6%	45.6%
	0.70	6.7%	
#1	0.39	10.8%	38.9%
	0.61	15.0%	
#1 Plastic Bag	0.25	6.0%	138.3%
	0.59	14.3%	
#1 Paper Bag	0.16	4.1%	95.1%
	0.32	8.0	

TABLE 5

Test No.	Ore	As Produced Yield B/Ton	Loss Due To Shrinkage B/T	Actual Yield B/T	% Assay
1F	#4L	49.8	4.7	45.1	82.0%
2D	#2L	84.0	5.0	79.0	91.9%
3D	#3L	74.2	4.5	69.7	88.6%
4E	#1L	88.5	9.5	79.0	85.2%

A-3
06152941

TABLE 6

BINDER TESTS - FIBER ANALYSIS

Test No.	Ore	Binder Type	Binder Location	Binder Rate	Drop Test Fiber Analysis (f/ml) Min.	Max.	Avg.	Actual Bagger Exposure (f/ml)
1A	L#4		Control		4.0	9.83	6.582	0.21
1B	4	O.E.	B.S.	0.033	8.98	13.68	10.333	1.21
1D	4	O.E.	B.S.	0.183	4.28	6.84	5.203	0.23
1E	4	O.E.	S.D.	0.39	4.28	11.54	7.270	0.78
1F	4	O.E.	S.D.	0.70	0.14	5.13	3.848	0.66
2A	L#2		Control		5.99	14.96	8.767	0.10
2B	2	C	B.S.	0.29	1.28	3.85	2.280	0.12
2C	2	C	S.D.	0.39	0.86	1.71	1.355	0.07
2D	2	C	S.D.	0.65	0.43	2.99	1.072	0.51
3A	L#3		Control		3.42	6.41	4.70	0.29
3B	3	C	B.S.	0.26	0.43	4.70	2.495	0.36
3C	3	C	S.D.	0.70	0.86	3.42	2.495	0.07
3D	3	C	S.D.	0.48	0.86	2.99	2.068	0.55
4A	L#1		Control		1.28	3.42	2.07	0.29
4B	1	S.S.	B.S.	0.37	0.43	0.86	0.717	0.36
4C	1	S.S.	S.D.	0.39	<0.43	0.43	0.215	0.07
4D	1	S.S.	S.D.	0.61	<0.43	0.43	0.215	0.57
4E	1	S.S.	S.D.	0.88	<0.43	0.86	0.143	0.74
5A	L#1	O.E.	B.S.	0.39	0.43	2.28	0.81	-
5B	1	O.E.	S.D.	0.47	0.43	2.14	1.21	-
5C	1	O.E.	S.D.	0.80	0.43	1.71	0.50	-
5D	1	O.E.	B.S.	0.052	0.38	4.99	3.105	0.50
5E	1	O.E.	B.S.	0.16	0.86	2.57	1.428	0.21
6A	L#3 MF		Control		5.56	8.55	6.843	.1
6B	3 MF	S.S.	B.S.	0.06	3.42	7.27	5.132	.45
6C	3 MF	S.S.	B.S.	0.10	1.71	3.42	2.638	.3
6E	3 MF	S.S.	B.S.	0.26	0.86	3.85	1.712	.36
7A	L#4 MF		Control		5.56	13.68	8.48	1.0
7B	4 MF	S.S.	B.S.	0.08	2.57	16.67	6.625	.59
7C	4 MF	S.S.	B.S.	0.09	2.57	6.41	4.918	.76
7D	4 MF	S.S.	B.S.	0.25	5.13	26.51	13.253	3.06

15152201

123Z00195

A-4 06152942

TABLE 7

FIBER EVALUATION - LIBBY #1

Date Prod.	Material Identification	Sampling Conditions		Fiber Analysis (f/ml)		
		Date	Location	Min.	Max	Avg.
3/23	Test 4A Control	3/29	Drop Test	1.28	3.42	2.07
3/23	Test 4B S.S. 0.37	3/25	Drop Test	0.43	0.86	0.717
3/26	Inventory	3/29	Drop Test	3.85	5.56	4.563
3/23	Test 4A Control	4/6	Drop Test Same as AF Job	2.57	5.99	4.99
3/23	Test 4B S.S. 0.37	4/6	Drop Test Same as AF Job	0.43	2.57	1.355
3/23	Test 4A Control	4/6	Home Sampling Attic Fill	3.62	4.28	3.95
3/23	Test 4B S.S. 0.37	4/6	Home Sampling Attic Fill	1.94	2.53	2.235

15152202

123Z00196

TABLE 8

A- 06152943

Test No.	Ore	Time	Bags Produced	Bagging Rate (4.0)	Production Yield	Assay	Rock	Assay
1A	#4L	60M	57	54.3				
B	"	"	58	56.3				
D	"	"	51	47.7				
E	"	"	45	46.5				
F	"	54M	47	55.2	49.2B/T	55	7.5%	15.9%
2A	#2L	60M	74	77.9				
B	"	37M	54	91.1				
C	"	60M	95	96.4				
D	"	56M	82	89.6	84 B/T	86	17.3%	17.4%
3A	#3L	60M	69	71.8				
B	"	"	69	70.9				
C	"	"	72	72.9				
D	"	54M	65	74.0	74.2 B/T	78.7	13.3%	14.5%
4A	#1L	60M	85	87.3				
B	"	"	79	82.2				
C	"	"	82	83.2				
D	"	"	87	88.3				
E	"	58M	80	84.6	88.5 B/T	92.7	8.1%	15.0%
5A	"	60M	74	75.3				
B	"	"	75	76.9				
C	"	"	76	77.3				
D	"	"	88	89.8				
E	"	"	86	86.9				
6A	#3LMF	60M	79	78.6				
B	"	"	84	87.4				
C	"	"	86	88.8				
E	"	"	83	84.7				
7A	#4LMF	60M	69	68.8				
B	"	"	69	64.2				
C	"	"	77	76.4				
D	"	"	77	75.7				

15152203

123Z00197

A-6 06152944

TABLE 9

Test No.	Initial Vol. Check		Final Volume Check		Loss cf	Position In Pallet
	In.	cf	In.	cf		
4A (No Spray)	2	4.2	3	4.05	.15	Partial Top
	2	4.2	3	4.05	.15	Partial Top
	2½	4.12	3	4.05	.12	Partial Bottom
	2	4.2	2	4.2	0	Full Top
	1½	4.27	2	4.2	.07	Full Middle
	2	4.2	2½	4.2	.08	Full Middle
	2	4.2	2½	4.12	.08	Full Middle
	2	4.2	2½	4.12	.08	Full Bottom
	3	4.05	3¼	4.01	.04	Full Top
	4	3.9	4½	3.83	.07	Full Top
	3½	3.98	4	3.9	.08	Full Middle
	3	4.05	3½	3.98	.07	Full Middle
	3	4.05	3	4.05	.0	Full Middle
	3½	3.98	4	3.9	.08	Full Top
4B (0.37 Sod.Sil.)	3	4.05	6 3/4	3.5	.55	Partial Bottom
	1½	4.27	5	3.76	.51	Partial Middle
	1½	4.27	5 3/4	3.64	.63	Full Top
	2½	4.12	5	3.76	.36	Full Top
	4	3.90	6½	3.53	.37	Full Middle
	3	4.05	5	3.76	.29	Full Middle
	1	4.34	3½	3.98	.36	Full Bottom
	1½	4.27	5	3.76	.51	Full Bottom
	2½	4.12	6	3.61	.51	Full Top
	3	4.05	7¼	3.42	.63	Full Top
	2½	4.12	5 3/4	3.64	.88	Full Middle
	½	4.42	4	3.90	.60	Full Middle
	3	4.05	7¼	3.42	.63	Full Bottom

15152204

123Z00198

A-7

06152945

TABLE 10

ATTIC FILL TEST JOB

Date	Job Site	Fiber Count (f/ml) Min.	Max	Avg.	T.W.A. 2/8	T.W.A. (Part) This Job	T.W.A. (Total) This Job
4/6	G.Kilmer Home Port Byron, N.Y.						
Unbound L#1 - Test No. 4A							
		3.62	4.28	3.95	0.988	0.362	0.576
Bound L#1 W/Sodium Silicate @ Bagging Spout 0.37 Qts./cf Test No. 4B							
		1.94	2.53	2.235	0.559	0.121	0.326

TABLE 11

MASONRY FILL TEST JOB

Date	Job Site	Fiber Count (f/ml) Min. Right	Max. Left	Avg.	T.W.A. 1/8	T.W.A. (Part) This Job	T.W.A. (Total) This Job
4/7	G.Kilmer Home Port Bryon, N.Y.						
Bound Libby #3 MF W/Sodium Silicate @ Bagging Spout 0.26 Qts/cf Test 6E							
		0.29	0.86	0.575	0.072	0.018	0.038
Bound Libby #4 MF W/Sodium Silicate @ Bagging Spout 0.25 Qts./cf Test 7D							
		2.01	3.02	2.515	0.314	0.079	0.168

15152205

123Z00199